

CLAIMS

What is claimed is:

1. A method of measuring fullness of a cryopump comprising:
coupling a pressure gauge in fluid communication with a vacuum region
5 behind a condensing surface of a cryopump; and
measuring pressure with the pressure gauge.
2. A method as in Claim 1 wherein the pressure gauge is an ion gauge.
3. A method as in Claim 1 wherein coupling the pressure gauge in fluid
communication with the vacuum region includes connecting the pressure gauge
10 to a tube or duct leading to the vacuum region.
4. A method as in Claim 1 further including adsorbing gases at the condensing
surface, the adsorbed gases consisting substantially of low-boiling-point gases.
5. A method as in Claim 4 wherein the low-boiling-point gases include at least one
of hydrogen, helium or neon.
- 15 6. A method as in Claim 1 wherein the vacuum region behind the condensing
surface has a pressure which is at least one order of magnitude less than a
process chamber coupled to the cryopump.
7. A method as in Claim 1 wherein the condensing surface further includes an array
of baffles coated with an adsorbent.

8. A method as in Claim 1 wherein the cryopump further includes first and second stage arrays, the condensing surface is within the second stage array.
9. A method as in Claim 8 wherein a partial pressure of hydrogen inside the second stage array is lower than a partial pressure of hydrogen outside the second stage array.
10. A method as in Claim 1 further comprising determining a pumping capacity of the cryopump using the measured pressure.
11. A method as in Claim 8 further includes predicting a pumping capacity for low-boiling-point gases based on the measured pressure.
- 10 12. A method as in Claim 1 further comprising determining an adsorption capacity of the cryopump using the measured pressure.
13. A cryopump comprising:
 - a closed cycle refrigerator;
 - a condensing surface cooled by the refrigerator; and
 - 15 a pressure gauge in fluid communication with a vacuum region behind the condensing surface.
14. A cryopump as in Claim 13 wherein the pressure gauge is an ion gauge.
15. A cryopump as in Claim 13 wherein the pressure gauge is connected to a tube or duct leading to the vacuum region behind the condensing surface.

16. A cryopump as in Claim 13 wherein gases are adsorbed within the condensing surface, the adsorbed gases consisting substantially of low-boiling-point gases.
17. A cryopump as in Claim 16 wherein the low-boiling-point gases include at least one of hydrogen, helium or neon.

5 18. A cryopump as in Claim 13 wherein the vacuum region behind the condensing surface has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.

10 19. A cryopump as in Claim 13 further includes first and second stage arrays cooled by the refrigerator, and the second, colder stage further including the condensing surface.

15 20. A cryopump as in Claim 19 wherein the condensing surface of the second, colder stage further includes:
 a second stage cryopanel surrounded by a radiation shield, the cryopanel having an array of baffles coated with an adsorbent, the baffles being coupled to and in close thermal contact with a heat sink on the second, colder stage.

20 21. A cryopump as in Claim 19 wherein a partial pressure of hydrogen inside the second, colder stage is less than a partial pressure of hydrogen outside the second, colder stage.

22. A cryopump as in Claim 13 further comprising an electronic controller which measures pressure with the pressure sensor, the controller including computer program instructions which determine a pumping capacity based on the measured pressure.

23. A cryopump as in Claim 22 wherein the controller further includes instructions to predict a pumping capacity of the cryopump for low-boiling-point gases based on the measured pressure.
24. A cryopump as in Claim 13 further comprising an electronic controller which measures pressure with the pressure sensor, the controller including computer program instructions which determine an adsorption capacity for the condensing surface using the measured pressure.
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25. A system for measuring fullness of a cryopump comprising:
a means for coupling a pressure gauge in fluid communication with a vacuum region behind a condensing surface of a cryopump; and
10 a means for measuring pressure with the pressure gauge.
26. A method of measuring fullness of a cryopump comprising:
connecting a pressure gauge in fluid communication with a vacuum region enclosed by cryopumping surfaces; and
15 measuring pressure with the pressure gauge.
27. A method according to Claim 26 wherein the pressure gauge is an ion gauge.
28. A method according to Claim 26 wherein connecting the pressure gauge in fluid communication with the vacuum region includes connecting the pressure gauge to a tube or duct leading to the vacuum region.
- 20 29. A method according to Claim 26 further including adsorbing gases at the cryopumping surfaces of the cryopump, the adsorbed gases consisting substantially of low-boiling-point gases.

30. A method according to Claim 29 wherein the low-boiling-point gases include any of hydrogen, helium or neon.
31. A method according to Claim 26 wherein the vacuum region enclosed by cryopumping surfaces has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.
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32. A method according to Claim 26 wherein the cryopumping surfaces further include an array of baffles coated with an adsorbent.
33. A method according to Claim 26 wherein the cryopump further includes first and second stage arrays, the cryopumping surfaces being within the second stage array.
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34. A method according to Claim 33 wherein a partial pressure of hydrogen inside the second stage array is less than a partial pressure of hydrogen outside the second stage array.
35. A method according to Claim 26 further comprising determining a pumping capacity of the cryopump using the measured pressure.
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36. A method according to Claim 35 further includes predicting a pumping capacity for low-boiling-point gases based on the measured pressure.
37. A method according to Claim 26 further comprising determining an adsorption capacity of the cryopumping surfaces using the measured pressure.
- 20 38. A cryopump comprising:
a cooled condensing surface; and

a pressure gauge in fluid communication with a vacuum region enclosed by the condensing surface.

39. A cryopump according to Claim 38 wherein the pressure gauge is an ion gauge.
40. A cryopump according to Claim 38 wherein the pressure gauge is connected to a tube or duct leading to the vacuum region enclosed by the condensing surface.
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41. A cryopump according to Claim 38 wherein condensing surface is used to adsorb gases, the adsorbed gases consisting substantially of low-boiling-point gases.
42. A cryopump according to Claim 41 wherein the low-boiling-point gases include at least one of hydrogen, helium or neon.
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43. A cryopump according to Claim 38 wherein the vacuum region enclosed by the condensing surface has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.
44. A cryopump according to Claim 38 further includes first and second stage arrays cooled by the refrigerator, and the second, colder stage further including the condensing surface.
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45. A cryopump according to Claim 44 wherein the condensing surface of the second, colder stage further includes:
a second stage cryopanel surrounded by a radiation shield, the cryopanel having an array of baffles coated with an adsorbent, the baffles being coupled to and in close thermal contact with a heat sink on the second, colder stage.
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46. A cryopump according to Claim 45 wherein a partial pressure of hydrogen inside the second, colder stage is less than a partial pressure of hydrogen outside the second, colder stage.
47. A cryopump according to Claim 38 further comprising an electronic controller which measures pressure with the pressure sensor, the controller including computer program instructions which determine a pumping capacity based on the measured pressure.
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48. A cryopump according to Claim 46 wherein the controller further includes instructions to predict a pumping capacity of the cryopump for low-boiling-point gases based on the measured pressure.
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49. A system for measuring fullness of a cryopump comprising:
a means for connecting a pressure gauge in fluid communication with a vacuum region enclosed by cryopumping surfaces; and
15 a means for measuring pressure with the pressure gauge.